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Seasonal movements and abundance of beluga in northern Quebec (Nunavik) based on weekly sightings information

Renseignements sur les déplacements saisonniers et l'abondance du béluga dans le nord du Québec (Nunavik) d'après les observations hebdomadaire

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ABSTRACT

The Department of Fisheries and Oceans maintains a harvest reporting system in the 14 villages located in northern Quebec (Nunavik). Data on numbers of animals reported struck, struck and lost and reported observed are recorded on a weekly basis. The reports on numbers of beluga reported observed by hunters were examined to determine if they could be used to examine seasonal movement patterns and to determine if any unusual trends had been observed in recent years. In Ungava Bay, more animals are seen during spring than during other parts of the year, but overall, the number of animals reported are low. Whales are observed throughout the summer, and continue to be seen into the fall. The largest numbers of whales reported were seen in Hudson Strait. Whales were reported from that area in May, with numbers increasing rapidly in June, then declining with few or no whales observed during late July, August and September. Reports indicate an increase in numbers of whales in the Hudson Strait area beginning in October. In Hudson Bay, few animals were observed during the spring, but reports of sighting increasing numbers of whales occurred throughout the early summer, with peaks in sightings from mid-July to early August. An increase in sightings was reported in mid-October, particularly in the northeastern portion of Hudson Bay. Considerable interannual variability in reported numbers of animals sighted were observed, but there was no obvious trend. In Hudson strait there appears to have been a shift in the fall peak of sightings from October to November.

RÉSUMÉ

Le ministère des Pêches et des Océans assure la tenue d'un système de déclaration des prélèvements dans les 14 villages situés dans le nord du Québec (Nunavik). Les données sur le nombre d'individus déclarés « abattus », « abattus et perdus » et « observés » sont enregistrées sur une base hebdomadaire. On a examiné les rapports sur le nombre de bélugas observés par les chasseurs pour déterminer s'ils peuvent être utilisés pour étudier les habitudes de déplacement saisonnier et pour déterminer si des tendances inhabituelles ont été observées ces dernières années. Dans la baie d'Ungava, on observe plus d'individus au printemps que pendant le reste de l'année mais, dans l'ensemble, le nombre d'individus observés est bas. On note des observations de bélugas tout au long de l'été, et celles-ci se poursuivent à l'automne. Le plus grand nombre d'individus déclarés a été observé dans le détroit d'Hudson. On a rapporté la présence de bélugas dans cette zone en mai ; par la suite, le nombre d'observations a augmenté rapidement en juin, puis a diminué avec peu ou aucun individu observé à la fin de juillet, en août et en septembre. Les rapports indiquent une augmentation du nombre de bélugas dans la zone du détroit d'Hudson à partir d'octobre. Dans la baie d'Hudson, peu d'individus ont été observés au printemps, mais les rapports indiquent que le nombre de bélugas observés a augmenté au début de l'été, atteignant un pic de la mi-juillet jusqu'au début d'août. On a noté une augmentation des observations à la mi-octobre, en particulier dans la partie nord-est de la baie d'Hudson. On observe une variabilité interannuelle considérable dans le nombre d'individus qui ont été observés, sans qu'il n'y ait toutefois de tendance nette. Dans le détroit d'Hudson, il semble y avoir eu un changement dans le pic des observations automnales, celui-ci passant d'octobre à novembre.

Introduction

Beluga whales (*Delphinapterus leucas*) were historically abundant in the coastal areas throughout Hudson Bay and James Bay (Reeves and Mitchell 1987a,b; Richard et al. 1990). Early evaluations separated beluga into at least three separate management units, an Ungava Bay stock, an Eastern Hudson Bay (EHB) stock, and a Western Hudson Bay (WHB) stock, based on their traditional areas of summer occupation (Finley et al. 1982; Reeves and Mitchell 1987 a,b). The status of beluga whales in James Bay was uncertain, with these animals being attributed to both EHB and WHB stocks (Reeves and Mitchell 1989). More recent analyses using mitochondrial DNA obtained from harvested animals supports the hypothesis that EHB beluga form a separate stock from WHB beluga (DeMarch and Postma 2003; Turgeon et al. 2009), but there are insufficient data to evaluate whether James Bay and Ungava Bay beluga also form separate stocks, and whether WHB animals should be further separated.

Nearshore aerial surveys to assess beluga abundance along the Hudson Bay coast of Quebec in 1978 and 1980 indicated that numbers were as low as 160–250 animals (Breton-Provencher 1980). Coastal surveys flown in Ungava Bay suggested even lower numbers of around 50 animals, concentrated around the Mucalic River (Finley et al. 1982). As a result of these low estimates, a series of systematic visual aerial surveys covering nearshore and offshore areas of James Bay, eastern Hudson Bay, and Ungava Bay were flown during July and August 1985. Although higher estimates were obtained in Hudson Bay, the overall conclusions from these surveys were that numbers were low (Smith and Hammill 1986). Subsequently, in 1986, at the Anguvigaq Annual General Meeting, quotas were assigned to all whale hunting communities in Nunavik, and this was followed by the adoption of a management plan which set a total northern Quebec quota of 236 beluga whales (Anonymous 1987; Reeves and Mitchell 1989). Since then, beluga harvesting has been limited by a management plan (reviewed in Lesage et al. 2001; Lesage and Doidge 2005; Lesage et al. 2009). In the most recent plan, the total harvest is limited to 178 whales, including an allowance for 30 whales to be taken as special pilot hunts (Anonymous 2008).

Beluga whales are considered by many Inuit to be sentient beings, with whom appropriate relationships must be maintained in order to ensure hunting success, and as a result they form part of the economic, social and cultural lives of many Inuit communities (Tyrrell 2007). In Nunavik, the management plan framework and in particular the recent reductions in total allowable catches have led to frustration and there are concerns that it is responsible for marked social and cultural changes in some communities (Tyrrell 2008). Tyrrell (2008) concluded that beluga management in Nunavik has been an unmitigated disaster, and there have been calls for the implementation of a co-management approach as a solution (Kishigami 2005; Tyrrell 2007, 2008). Until now the legislative framework for co-management has not been in place, but in December 2006, the Nunavik Inuit Land Claims Agreement (NILCA) was signed. NILCA sets out the legal framework, which will result in the formation of a management board to oversee the co-management of marine resources in Nunavik (http://www.nilca.org/).

One of the concerns to hunters in Nunavik has been the belief that the Traditional Ecological Knowledge (TEK) of the hunters, those living in the Nunavik area, is not considered in the scientific or management process. TEK has been defined as the knowledge claims of persons who have a lifetime of observation and experience of a particular environment, and as a result function effectively in that environment (Usher 2000). Many studies have pointed out the necessity and benefits of incorporating TEK into resource management and policy development (for some review see Lewis et al. 2009). For example, early research on ringed seals relied heavily on TEK to learn more about the subnivean lair structure of ringed seals (*Pusa*

hispida)(Smith and Stirling 1975) and more recently, the Inuit bowhead knowledge study indicated that the abundance of eastern Arctic bowhead had increased markedly since the early 1900s and was probably much higher than most people had considered (NWMB 2000). However, trying to convert TEK knowledge into quantitative data remains a challenge, and little attempt has been made to subject TEK to the same level of rigorous peer review, as normally occurs with western science-based information. Such efforts are needed if TEK is to be used effectively for assessment and management purposes (Usher 2000).

Under the James Bay agreement and beluga management plans, catch statistics have been recorded since 1974. Along with the catch data, information on numbers of whales seen and observations on other species have been recorded since 1998. These data have not been collected using a formalized interview process. However, they do provide a record of weekly observations that have been collected in a standard format and might be used to examine seasonal changes in coastal distribution or trends in abundance over time.

Materials and Methods

In 1998, Fisheries and Aquaculture Management of the Department of Fisheries and Oceans initiated a sampling program among the villages in northern Quebec (Fig. 1). In each village a person was hired and requested to complete weekly reports on numbers of whales sighted, whales landed and number of whales struck and lost. In addition to this program, hunters were requested to provide skin samples and a tooth, and to complete a data form on harvested whales. For this information they received a reward. Since 1998, the program has been managed under different frameworks, with the current model involving a contract to the Kativik Regional government to recruit and train collectors and obtain weekly statistics from each of the 14 communities. The community representatives, now called Renewable Resources Officers, collect data on numbers of whales seen, number of whales struck and landed as well as numbers of animals lost. They also coordinate collection of biological samples.

The study area included the coastal areas surrounding Nunavik. This region is inhabited by a combination of Inuit, First Nations, belonging to the Cree Nation, and non-natives. Inhabitants are distributed among the 14 villages of Nunavik, which can be divided into three regions: Ungava Bay, Hudson Strait and Eastern Hudson Bay. These regions were further subdivided to group observations from villages on similar coasts. These regions were eastern Ungava Bay (Kangiqsualujjuaq), southern Ungava Bay (Kuujjuaq, Tasiujaq), and western Ungava Bay (Aupaluk, Kangirsuk); Hudson Strait was divided into eastern Hudson Strait (Quaqtaq, Kangiqsujuaq) and western Hudson Strait (Salluit, Ivujivik); Eastern Hudson Bay was divided into northeastern Hudson Bay (Akulivik, Puvirnituq), and eastern Hudson Bay (Inukjuak, Umiujaq, and Kuujjuarapik).

Data collected between 2001 and 2008 are examined here, whereas data from 1998 and 1999 were discovered too late to be included. The numbers of whales reported on a weekly basis in each community were summed across each region or sub-region, averaged across all years, then expressed as a proportion of the maximum weekly numbers of whales reported sighted, or were summed across months and were used to examined inter-annual variability in sighting records.

Results

Seasonal movements

Along the eastern shore of Ungava Bay (Kangiqsualujjuaq), whales are seen as early as mid-May (week 21)(Fig. 1, 2). Although numbers are low (averaged maximum of about 6 animals), they continue to be seen throughout the spring and summer with some periodicity in observations and peaks about 4-5 weeks apart. Animals disappear in September, but return again in October and are seen well into November.

Compared to eastern Ungava Bay, more whales are reported sighted from southern Ungava Bay (Max = 103) and western Ungava Bay (Max = 1252). However, the first sightings in these latter areas occur in early June, which is about 2 weeks later than observations from eastern Ungava Bay. In southern Ungava Bay, the largest numbers of animals sighted are reported from early June. After that, low numbers of whales, on average about 10 animals, are reported throughout June and early July; but the average number of sightings increases to a peak of about 20 whales by the end of July-beginning of August, then fall off rapidly. Low numbers of sightings of beluga whales continue to be reported into the autumn until about early November. In western Ungava Bay, beluga whales are also first reported in early June. Larger numbers of animals on the order of 100 animals are reported in the weekly sighting reports during a three-week period throughout June, but sightings fall off rapidly by the beginning of July. Whales are not reported from early August until large numbers are reported again in late October (Fig. 1, 2).

Of all regions, the eastern Hudson Strait area has the highest number of sightings (Max = 2054). Whales are first reported from this area in late May/early June, which is at about the same time as observations reported in western Ungava Bay. Although only a few whales are reported the first couple of weeks, sightings increase rapidly to peak levels in early June, then decline slowly. Some whales are reported from this area in July, but few or no whales are reported after early August (Fig. 3). New sightings of whales are reported again in early October, with numbers peaking by late October. Large numbers of animals continue to be seen until late November (Fig. 3). In western Hudson Strait, fewer whales overall are reported than in eastern Hudson Strait, but whales are seen one to two weeks earlier in early to mid-May. There is a build-up in sightings which reaches a peak by late June. Compared to the sightings information from eastern Hudson Strait, this build-up is not as rapid, and a greater number of sightings are reported throughout the summer. In eastern Hudson Strait the greatest number of sightings are reported from the spring/early summer, whereas in western Hudson Strait the greatest number of sightings are reported from the fall, with peak sightings occurring in mid-October, with no reports after mid-November.

In northeastern Hudson Bay, beluga could be seen as early as mid-May, but reported sightings were very few and occasional in nature throughout the spring and summer months (Fig. 4). It was not until the fall months, beginning in mid-October, that more animals were seen. Numbers peaked in late October (Max = 907), before falling off rapidly, although a few whales were still reported in early November. In eastern Hudson Bay, a few whale sightings were reported in late May, but average weekly counts remained below 50 animals until mid-July, when the number of sightings increased rapidly to a maximum in late-July (Max = 448), before falling off, with few animals being reported after mid-August (Fig. 4). Sightings remained low throughout the fall, with a sudden spike in reported sightings in early October.

In Ungava Bay there was considerable inter-annual variability in total number of reported sightings and in the period when first sightings were reported in any year. However, there was

no evident trend between years in total number of sightings, nor in the timing of peak numbers. Taking all of Ungava Bay together, the peak in sightings was reported in July, with numbers declining during the rest of the summer, then a small increase in sightings in October and November (Fig. 4). In Hudson Strait, there were peaks that were consistently observed each year in the spring and in the fall, as was observed when the Strait was divided into east and west. Overall, the greatest number of sightings was reported during spring in June, with a second peak in October-November. Although samples sizes are still quite small (N = 8 years), in recent years there has been a shift in the fall peak of sightings from October to November. In eastern Hudson Bay, when all communities are included, again there is no evident trend in when the first sightings are reported or in total numbers, but the peak occurs in July-August, with a second, sometimes quite significant peak in October. The extremely high numbers of belugas observed in 2002 are due to a report of 7,125 whales sighted in October from the village of Akulivik. The July-August and October peaks in sightings are retained when sightings are restricted to the arc area of eastern Hudson Bay, but the fall peak is generally much smaller than the summer peak (Fig. 6).

Discussion

The data presented here are sightings of beluga whales reported to community agents in each of the villages in Nunavik throughout the year. The quality of these observations will be affected by the observation efforts and personalities of hunters and agents in each of the communities, and their dedication to report and collect the information on a weekly basis. For example, if hunters are not on the coast, or if the agent is out of town, then few observations might be reported. Conversely, if hunters are on the water and agents are out with them or are in town, then the corresponding sightings of whales might be quite high. The reporting of sightings may also be affected by community views towards the data collection and quite possibly attitudes towards the management plan. In spite of these challenges the data do provide some interesting observations on the seasonal distribution of animals, particularly when considered within the context of information from other sources.

Aerial surveys, interviews with hunters, catch statistics, satellite telemetry and reports from the literature provide interesting information on the seasonal movements and distribution of beluga whales in the waters around Nunavik (Finley et al. 1982; Kingsley et al. 2001 Hammill et al. 2004; Richard 2005; Lewis et al. 2009). During the fall, there is a movement of animals into Hudson Strait, with some animals continuing eastwards down the Labrador coast as far south as Hopedale. Of all areas, the greatest number of animals observed are from reports from the Hudson Strait area. Genetic analyses of animals reported taken in the fall harvest indicates that whales from both the very large western Hudson Bay population numbering around 57,000 (95% C.L.: 37,700-87,100) (Richard 2005) animals and the eastern Hudson Bay population of around 3,000 whales are moving into and through Hudson Strait (Hammill et al. 2008; Turgeon et al. 2009; De March and Postma 2003). Although overall there does not appear to be any trend in numbers of animals observed, there does appear to be a shift in the peak of fall sightings in Hudson Strait from October to November. Beginning in early May, there is a reverse migration with beluga whales moving out of Hudson Strait to return to their summering areas. In eastern Hudson Strait, the peak number of observations occurs during spring and overall, the number of reported sightings is much higher than from the western portion, whereas in the western portion of the Strait more animals are reported in fall. The build-up in numbers in these areas suggests stageing or local feeding before animals move elsewhere. The large number of fall sightings in the western Hudson Strait area might suggest that the fall migration is more coastal, leading to more observations; alternatively, animals may be lingering longer in the area,

possibly to feed. Such stops during the fall migration have been observed among high Arctic beluga and may be related to feeding (Smith and Martin 1994). Although some beluga whales continue to be seen throughout the summer months in the Strait area, particularly in the western portion, the number of sightings is very low, and coastal surveys in the area have not detected any significant concentrations (Finley 1982; Gosselin et al. 2002; Gosselin et al. 2009).

Some beluga migrating through Hudson Strait move into Ungava Bay for a short time during the fall, and early winter, but tend to remain offshore due to ice (Kingsley et al. 2001; Lewis et al. 2009). In western Ungava Bay, large numbers of beluga whales have been reported in the fall, but this likely reflects the brief movement of animals from the Hudson Strait area into the northwestern part of the bay. Summer observations of beluga whales in Ungava Bay suggest that this population still exists, but the low numbers of animals reported and several aerial surveys indicate that numbers remain very low (Hammill et al. 2004; Gosselin et al. 2009). Unfortunately, the genetic relationships of summering animals in Ungava Bay have not been studied.

The return migration of beluga leaving Hudson Strait begins in May. Although observations of animals are reported in May in the eastern Hudson Bay arc area, there are almost no reports of animals from the northeastern part of Hudson Bay. Returning beluga are thought to remain offshore owing to heavy ice conditions, making their way to the Nastapoka and Little Whale River areas. Some observations in eastern Hudson Bay also indicate overwintering in the area. The stock relationships of these animals to other beluga are uncertain but some animals do overwinter in southern Hudson Bay or James Bay (Jonkel 1969; Lewis et al. 2009; Hammill unpublished data). The peak in sightings of animals in eastern Hudson Bay occurs during July-August, when many animals are undergoing extensive inshore-offshore movements (Kingsley et al. 2001; Hammill unpublished data). The sighting data suggest that a large proportion of the population may move inshore at any one time, but does not suggest any obvious trend in abundance over time.

Reviews of historical harvest records, primarily from the Hudson Bay company indicate that beluga were once abundant in the coastal waters around northern Quebec (Reeves and Mitchell 1987a, b). Aerial surveys flown over eastern Hudson Bay, Hudson Strait and Ungava Bay circa 1980, reported large numbers of belugas in Hudson Strait, but very low numbers in eastern Hudson Bay and Ungava Bay (Breton-Provencher 1980; Finley et al. 1982). Conservation concerns about beluga in these areas led to the adoption of management plans beginning in 1986 to limit harvesting in eastern Hudson Bay and Ungava Bay. Meetings with Nunavik hunters in recent years have led to suggestions that beluga abundance in Nunavik waters has increased, that surveys should be flown at other times of the year and that the Hudson Strait area should also be surveyed. Early attempts to develop management units for beluga suggested that beluga should be separated into Ungava Bay, eastern and western Hudson Bay populations (Reeves and Mitchell 1989). More recent mitochondrial DNA analyses have provided support for the two stock (eastern and western Hudson Bay) hypothesis and has also shown that the large numbers of beluga whales in Hudson Strait consist of two or more mixed stocks that likely overwinter in that area (De March et al. 2003). Thus, surveys in this area would not be helpful in evaluating the abundance of the beluga population that summers along the eastern coast of Hudson Bay. Reports from hunters indicate that beluga whales largely exit this area during summer. They also indicate that beluga whales still summer in eastern Hudson Bay and Ungava Bay and that late July to August are likely the best times to survey these animals, when they are most abundant. Overall, numbers do not appear to be increasing in either area, and the low number of sightings in Ungava Bay during summer suggests that this population remains particularly small.

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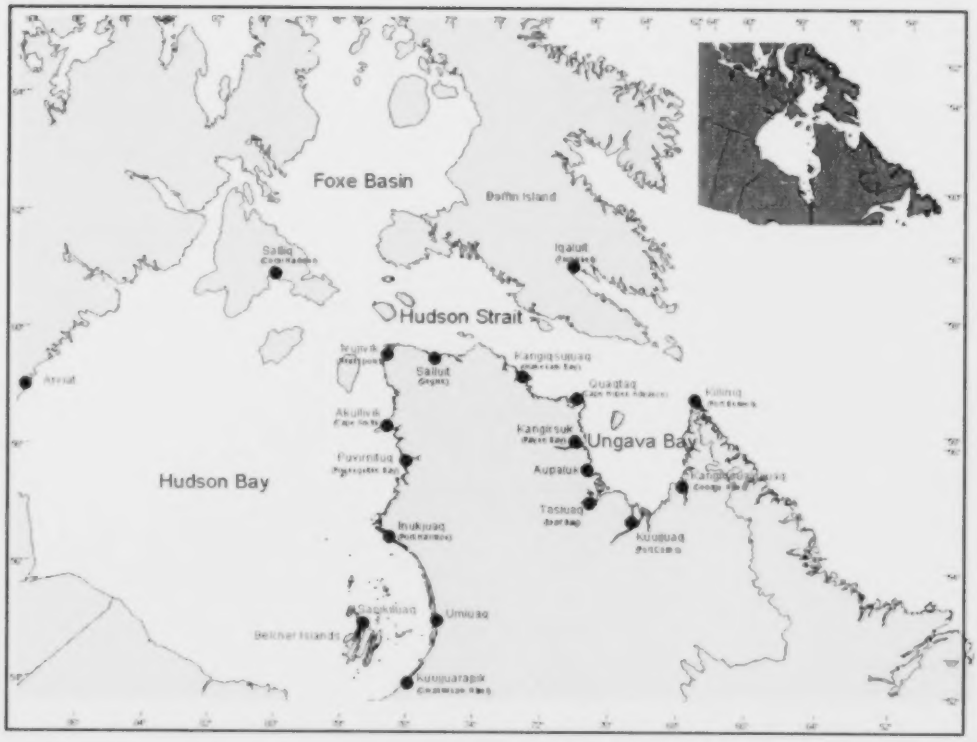


Figure 1. Location of villages where beluga whale hunt and sightings statistics are reported from in northern Quebec (Nunavik).

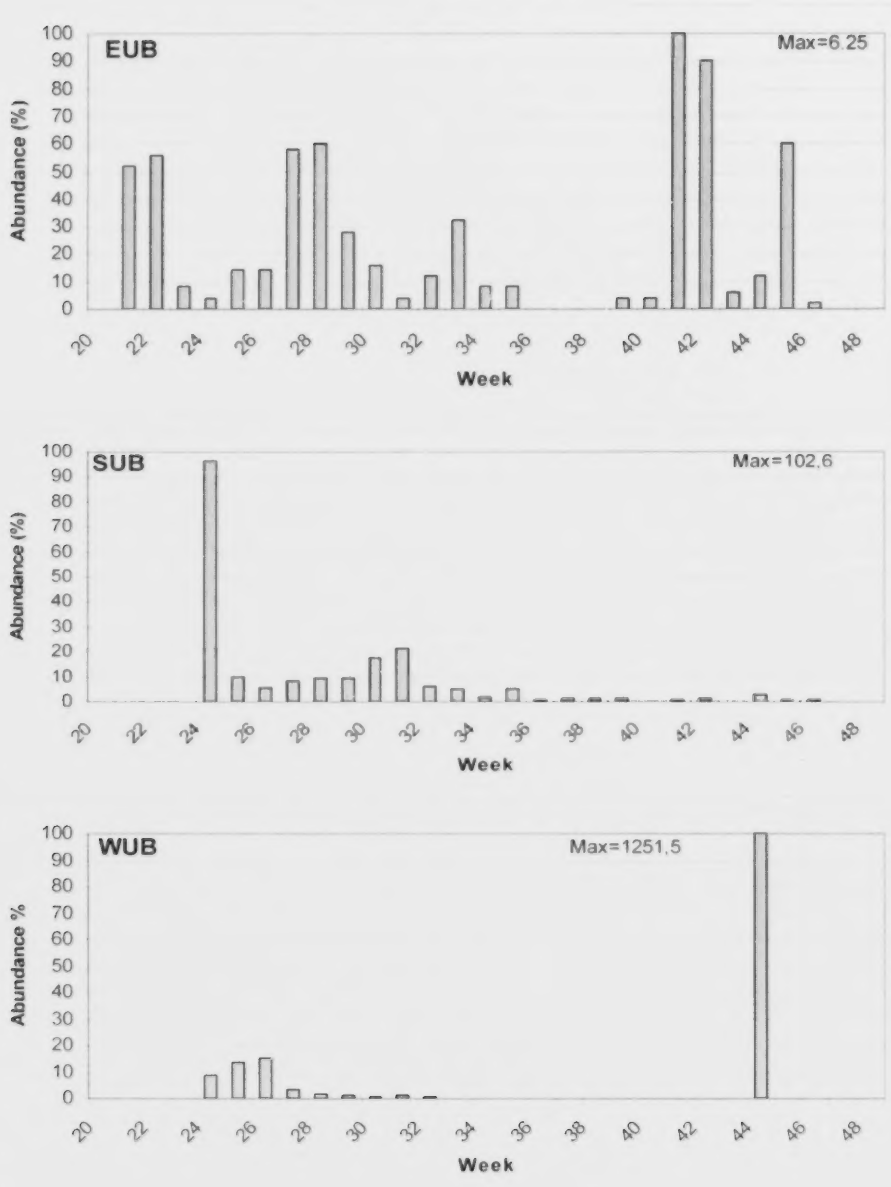


Figure 2. Seasonal changes in relative abundance in each of the three main areas: Ungava Bay, Hudson Strait and Hudson Bay. The sum of the sightings in each region in each week were average over the 8 years of data, then converted to a percentage by dividing the totals by the largest number of animals reported. Week 20 is approximately the second week in May, week 46 is approximately the first week in November.

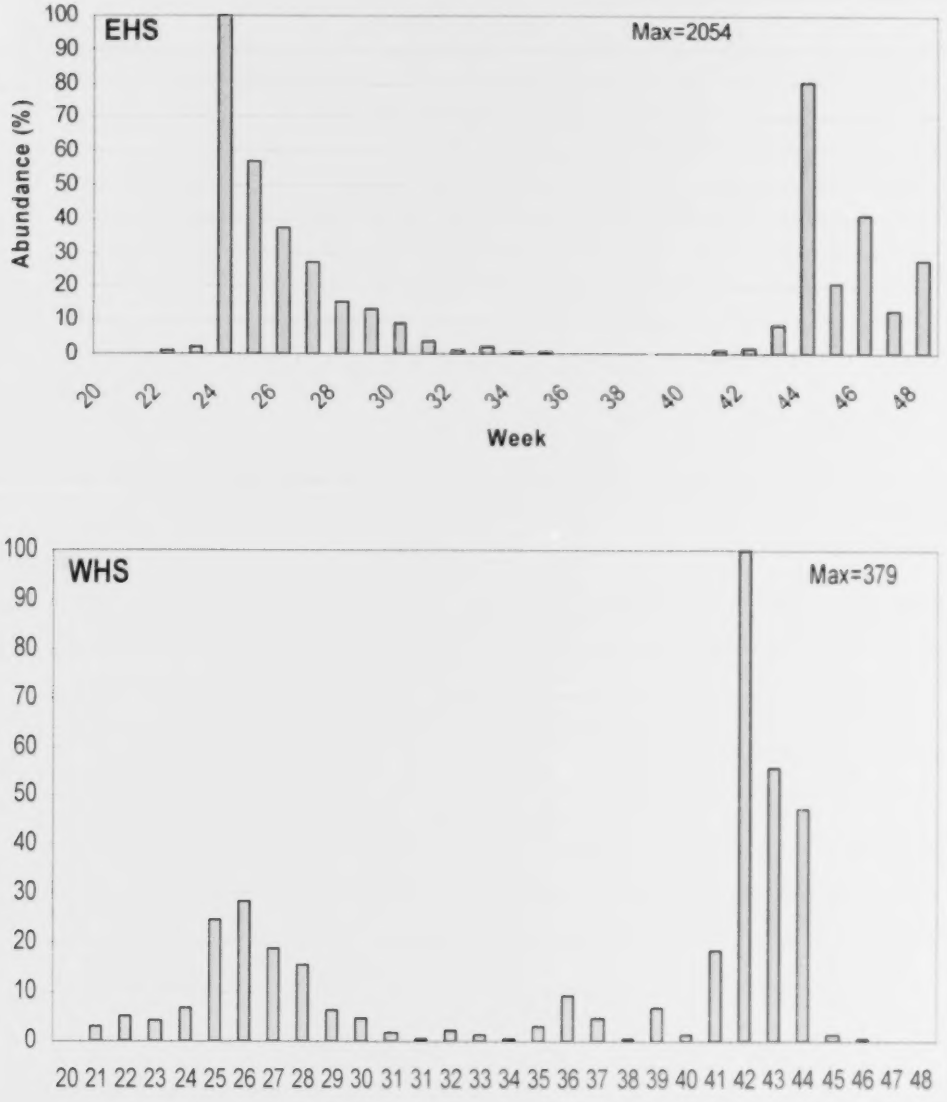
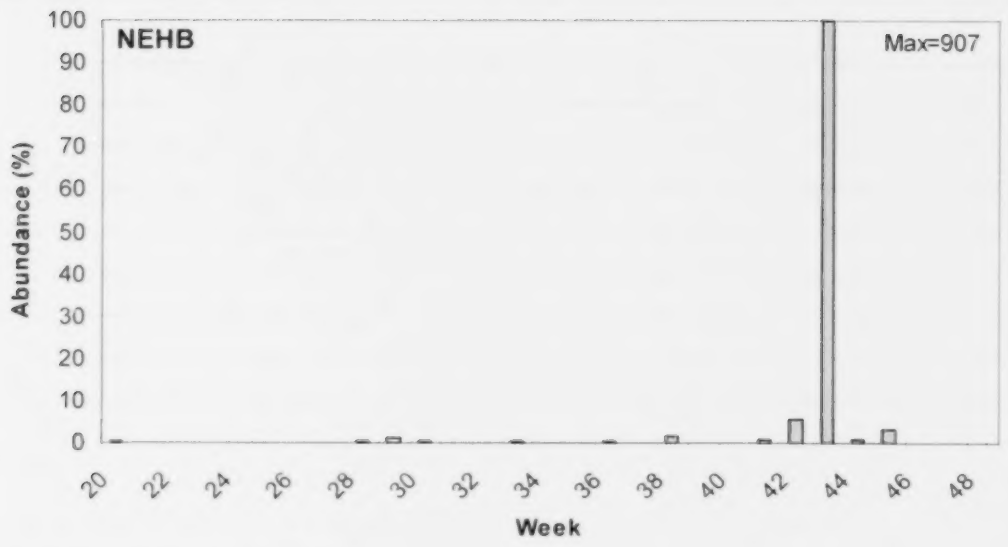


Figure 3. Seasonal changes in relative abundance in each of the three main areas: Ungava Bay, Hudson Strait and Hudson Bay. The sum of the sightings in each region in each week were average over the 8 years of data, then converted to a percentage by dividing the totals by the largest number of animals reported. Week 20 is approximately the second week in May, week 46 is approximately the first week in November.



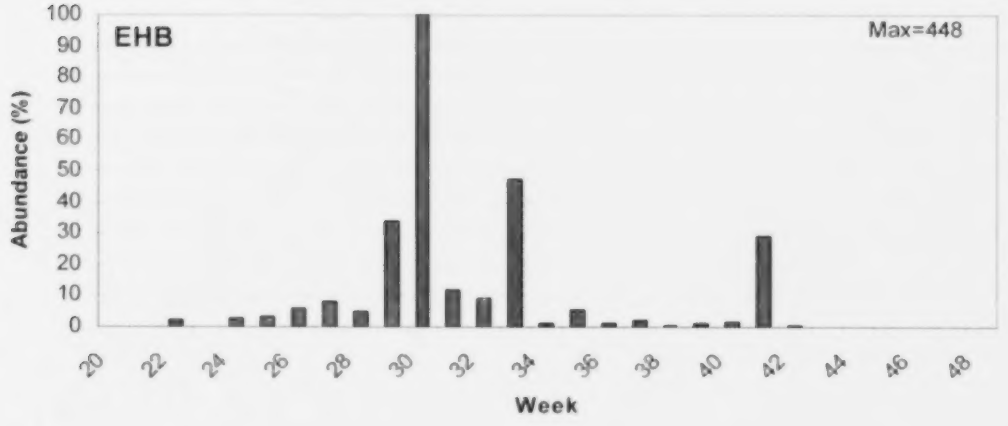


Figure 4. Seasonal changes in relative abundance in each of the three main areas: Ungava Bay, Hudson Strait and Hudson Bay. The sum of the sightings in each region in each week were average over the 8 years of data, then converted to a percentage by dividing the totals by the largest number of animals reported. Week 20 is approximately the second week in May, week 46 is approximately the first week in November.

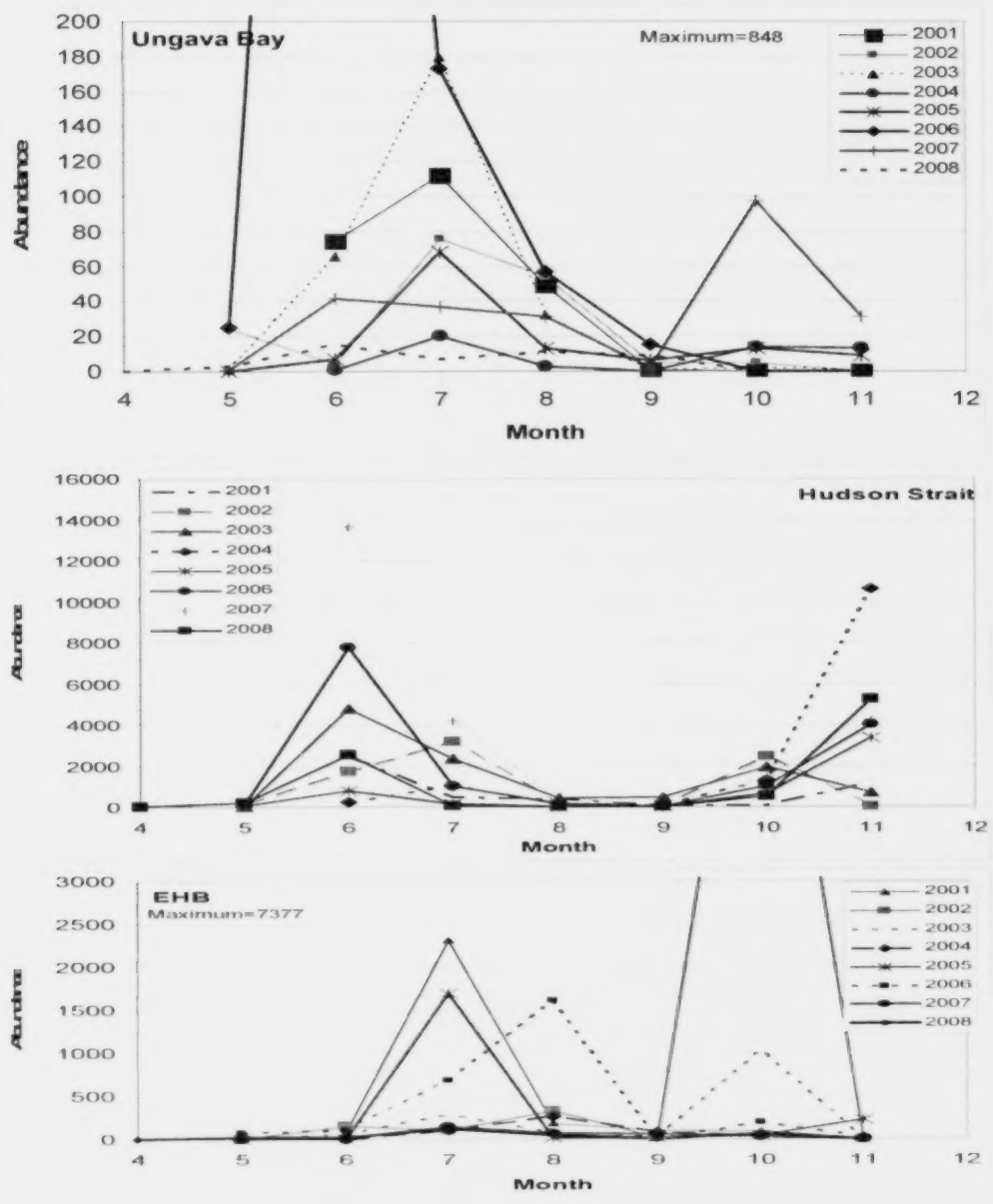


Figure 5. Seasonal changes in the total number of whales reported sighted in each of the three main areas: Ungava Bay, Hudson Strait and Hudson Bay.

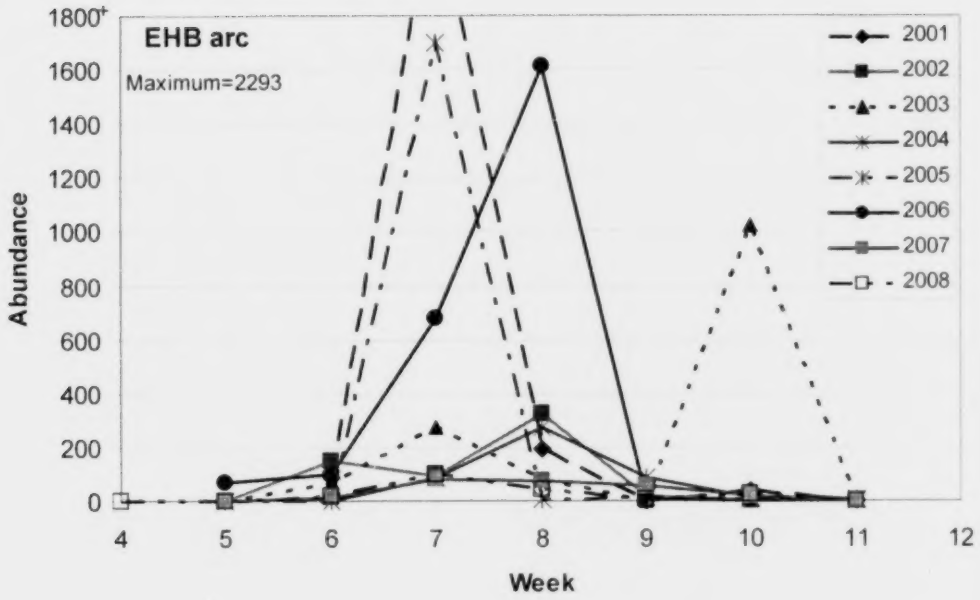


Figure 6. Total number of whales reported sighted by month and year in the arc area of eastern Hudson Bay.